ANCYLOSTOMES RECORDED FROM SIXTY-SEVEN POST-MORTEMS PERFORMED IN AMAZONAS

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(*Received for publication* 12 *June*, 1922)

This paper deals with the ancylostomes collected at sixty-seven autopsies, performed in the Santa Casa Hospital, Manáos, during 1921 and the beginning of 1922. With very few exceptions, all the subjects had resided for the greater part of their lives in the State of Amazonas, Brazil. They divided themselves into two natural classes:—(1) The 'Town-dwellers' and (2) the 'Country-dwellers,' the latter mostly agriculturalists, rubber-workers, etc., who either came into the town to be treated for sickness, or else who were taken ill when temporarily residing there.

METHOD OF COLLECTION. The gut having been opened, all ancylostomes, attached or lying loose in the lumen, were removed. The contents of the bowel were then distributed in large, flat, white dishes and examined for ancylostomes during three washings. All worms were washed in normal saline, killed with hot 75 per cent. alcohol, and stored in lacto-phenol (Leiper).

METHOD OF EXAMINATION. In the first part of the investigation an attempt was made to estimate the accuracy of a hand-lens (× 8) examination of the worms in order to determine sex and species. For this purpose, the worms obtained from fifteen post-mortems were examined as follows:—First with a hand-lens and a tentative diagnosis made as to sex and species (*i.e.*, whether *Necator americanus* or *A. duodenale*). They were then re-examined with a microscope, using the half-inch and the one-sixth.

The points of distinction noted, during the hand-lens examina-

tion, were (1) the general fineness, and (2) the sharply defined head curve, of *Necator americanus* as compared with *A. duodenale*. In this manner six hundred and sixty-two worms were examined; these consisted of eighty-five *A. duodenale* and five hundred and seventy-seven *Necator americanus*. The result was as follows:—One worm was diagnosed wrongly (*Necator americanus* male, mistaken for *A. duodenale* male); three other worms necessitated microscopical examination, but two of these proved to be so damaged that the head curve was destroyed; the remaining six hundred and fifty-eight worms were found to have been correctly diagnosed with the hand-lens.

With a view to testing whether *A. caninum* or *A. braziliense* could be distinguished from *A. duodenale* and *A. necator*, one male and one female *A. caninum* and one male *A. braziliense* (all from a cat) were mixed with sixty *Necator americanus* and eighteen *A. duodenale*. The worms were then separated into their species by the aid of a hand-lens, the result checked by a microscope and found to be correct.

The distinctions between *A. necator* and *A. caninum* or *A. braziliense* were based on the characteristic head curve of *A. necator*, between *A. duodenale* and *A. caninum* or *A. braziliense* on the smaller size and general fineness of the latter two species.

As this method appeared sufficiently accurate, the worms were sorted with a hand-lens in all subsequent examinations, any doubtful specimens, and these averaged one in sixty, being placed on one side and subsequently examined microscopically.

RESULTS. These are published in the form of a table for comparison with Darling and Smillie's (1921) figures for Brazil. Apparently their results are drawn from Southern Brazil, chiefly from Rio, Pernambuco, Sao Paulo, and a few from the State of Matto Grosso.

They state that 'the groups studied were all more or less similar in that they were composed largely of agriculturists. The average hookworm count of 136·1 per case, therefore, does not represent the degree of infection of *all Brazil*, but of *rural Brazil*.'

As my results are drawn from two classes, a second table is published showing a comparison between town and country infections. It must be noted that a few of the cases recorded had at one

time or another been in hospital, and a certain number of those had undoubtedly received Chenopodium.

On examining Table I, it will be seen that the most striking difference between the figures for Amazonas and South Brazil lies in the proportion of *Necator americanus* to *A. duodenale*, and, on examining Table II, that this difference is mainly due to the high average number of *A. duodenale* occurring in the country dwellers. Whereas Darling's rural dwellers for South Brazil show a proportion of *Necator americanus* to *A. duodenale* of 45 to 1, rural dwellers in Amazonas show a proportion of only 3·2 to 1.

Ancylostoma braziliense in human beings. Four worms belonging to the species *A. braziliense* were found among the six thousand eight hundred and fifty-seven ancylostomes, collected from the sixty-seven post-mortems. There were two males and two females; the males measured about 7 mm. in length and the females 7·5 mm.

Each worm was found in a separate host. Two were found in native Amazonians who, so far as is known, had never left the State of Amazonas; one in a patient who originally came from Ceara, and one in an American of the 'beach comber' type who had lived some twenty years in North Brazil.

I can find no previous record of *A. braziliense* being found as a human parasite in America. De Faria (1916) states that he examined children in Rio for this infection without success. Darling and Smillie (1921) do not record it among the sixty three thousand nine hundred and twenty-three hookworms they examined in South Brazil; but Darling (1920) writes:—'The ancylostomes encountered in man are *A. duodenale*, *A. ceylanicum*, *A. braziliense*, *Necator americanus*.' I cannot, however, find the authority on which *A. braziliense* is included.

According to de Faria (1910 and 1916) and Clayton Lane (1916), the distinction between *A. braziliense* and *A. ceylanicum* depends on the following two points:—

(1) *The inner ventral tooth.* This is smaller and finer in *A. braziliense* than in *A. ceylanicum.*

(2) *The bursa of the male.* De Faria (1916) states that in *A. braziliense* the rays, especially the dorso-external, are characterised by their great length, fineness and delicacy, whilst those of *A. ceylanicum* are shorter and thicker.

TABLE I

Comparing Ancylostome Infections for Amazonas and South Brazil.

	Amazonas July, 1921 to February, 1922	South Brazil (Darling) April, 1918 to January, 1920
Number of cases examined	67	469
Number of Ancylostomes found	6,857	63,923
Number of *Necator americanus*	5,660	62,554
Number of *A. duodenale*	1,193	1,369
Number of *A. braziliense*	4	—
Proportion of *Necator americanus* to *A. duodenale*	4·7 : 1	45 : 1
Average number of Ancylostomes to each individual	102·3	136·1
Average number of *Necator americanus* to each individual ...	84·4	133·2
Average number of *A. duodenale* to each individual	17·8	2·9

TABLE II.

Comparing Ancylostome Infection of Country and Town Dwellers in Amazonas.

	Country Dwellers	Town Dwellers
Number of cases examined	39	28
Number of Ancylostomes examined	4,144	2,713
Number of *Necator americanus*	3,157	2,503
Number of *A. duodenale*	985	208
Number of *A. braziliense*	2	2
Proportion of *Necator americanus* to *A. duodenale*	3·2 : 1	12 : 1
Average number of Ancylostomes to each individual	106·2	96·8
Average number of *Necator americanus* to each individual ...	80·9	89·3
Average number of *A. duodenale* to each individual	25·2	7·4

The distinction between the two was disputed by Leiper (1913). I have had the opportunity of comparing the following ancylostomes:—

(1) *A. braziliense* from cats and dogs in N. Brazil.
(2) *A. braziliense* from human subjects in N. Brazil.
(3) *A. ceylanicum* from cats and dogs in Bengal, India. (Material kindly supplied by Lt.-Col. Clayton Lane.)
(4) *A. ceylanicum* from West African dogs and South African cats.

As a result of careful examination of many specimens, I was unable to confirm the specific differences mentioned by de Faria and Clayton Lane.

No constant difference could be detected in the size and shape of the inner tooth of *A. braziliense* and *A. ceylanicum*, nor could any difference be discovered in the length and fineness of the dorso-external ray in the two worms (*vide* table).

TABLE III.

Comparing Measurements of the Dorso-external Ray in *A. ceylanicum* and *A. braziliense*

As named	Locality	Host	Number examined	Average length of worm	Average breadth D.E.R.	Average length D.E.R.	Ratio length D.E.R. to length worm	Ratio breadth D.E.R. to length worm
				mm.	μ	μ		
A. ceylanicum	Berhampore, Bengal	Cat ...	3	5·6	14	176	1 : 31	1 : 400
A. ceylanicum	Berhampore, Bengal	Dog ...	1	7·5	21	217	1 : 34	1 : 357
A. ceylanicum	Accra, West Africa	Dog ...	3	7·0	20	270	1 : 25	1 : 350
A. braziliense	Manáos, North Brazil	Dog ...	4	6·5	17	171	1 : 38	1 : 382
A. braziliense	Manáos, North Brazil	Cat ...	3	6·1	17	186	1 : 32	1 : 358
A. braziliense	Manáos, North Brazil	Human	2	7·0	14	162	1 : 43	1 : 500

SUMMARY

Six thousand eight hundred and fifty-seven ancylostomes collected from sixty-seven autopsies performed in Manáos, Amazonas, were examined, with the results recorded. A far higher proportion of *A. duodenale* to *Necator americanus* (1 : 4·7) occurred in Amazonas than recorded by Darling for South Brazil (1 : 45). This high proportion of *A. duodenale* was shown to be chiefly due to the country dwellers in Amazonas, whose *A. duodenale* to *Necator americanus* ratio was 1 : 3·2, while that of the city dweller was 1 : 12.

A. braziliense was found in four of the post-mortems.

The comparison of these worms and other two-toothed ancylostomes from dogs and cats in N. Brazil and India, and also from cats in South Africa and dogs in West Africa, failed to show the difference claimed to exist by de Faria between *A. ceylanicum* and *A. braziliense.*

My thanks are due to Dr. Thomas for much of the post-mortem material.

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